World Journal of Pharmaceutical and Life Sciences

www.wjpls.org

Impact Factor: 7.409 Coden USA: WJPLA7

COMPARATIVE STUDY BETWEEN LASER AND CONVENTIONAL TECHNIQUES FOR LOWER EYELID REJUVENATION

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DOI: https://doi.org/10.5281/zenodo.18480560

How to cite this Article: Samih M. Alqadi[1*], Lana S. Alanazi[2], Elmuaiz Widatalla[3], Yasmin Y. Alhazime[4], Dania Raffa[5], Abdulaziz Almutairi[6] (2026). Comparative Study Between Laser And Conventional Techniques For Lower Eyelid Rejuvenation. World Journal of Pharmaceutical and Life Science, 12(2), 180–190.

Article Received on 05/01/2026 **Article Revised on 25/01/2026** **Article Published on 01/02/2026**

ABSTRACT

Lower eyelid blepharoplasty is a popular aesthetic surgery that restores the youthful appearance of the lower eyelid by excising redundant skin and removing prolapsed fat. However, complications may occur, and various techniques have been developed to improve outcomes and prevent complications. The periorbital region has seen exponential growth in aesthetic procedures, making it the most commonly treated area. Conventional techniques for lower eyelid rejuvenation are discussed, with focus on surgical options as they yield permanent results. Non-surgical techniques are generally considered inferior to surgical procedures and not elaborated upon. Laser blepharoplasty is a modern adaptation of traditional blepharoplasty that utilizes laser technology to improve efficacy while reducing complications and recovery times. The efficacy assessment of laser and conventional methods in lower eyelid rejuvenation focuses on treatment outcomes from practitioners versus cohorts using similar techniques. Understanding these risks is important for obtaining informed consent from patients and planning appropriate pre-operative discussions. Future directions and emerging technologies are essential in lower eyelid rejuvenation, with advanced laser technologies becoming prominent and post-treatment care innovations being critical. Aesthetic practitioners must keep pace with these advancements while ensuring that techniques and protocols are well-understood and optimized for patient care.

KEYWORDS: Lower eyelid blepharoplasty, Laser blepharoplasty, Conventional techniques, Laser technologies, Rejuvenation.

INTRODUCTION

With population aging, patients' need for aesthetic improvement is increasing dramatically. Lower eyelid blepharoplasty is one of the most commonly requested aesthetics surgical procedures.[1] It has undergone evolution since its inception, from pure excision of skin and fat to a more complex procedure requiring knowledge of eyelid anatomy and function.[2] The objective of the procedure is to restore the youthful appearance of the lower eyelid by concomitantly excising redundant skin and removing prolapsed fat.[3]Although improvement is usually achieved, unexpected complications may occur, as is the case with other surgical procedures.[4] Attempts to enhance the outcome and prevent complications following lower eyelid blepharoplasty have spurred the development of various techniques that may be roughly classified as either conventional or laser.[5] A thorough understanding

of the principle of both approaches is essential for optimal clinical application.[6]

In recent years, there has been an exponential growth in the number of aesthetic procedures performed globally.[7] In particular, there has been a dramatic increase in the number of procedures performed on the periorbital region, making it the most commonly treated area.[8] Despite the dramatic advances in rejuvenation techniques, efforts to enhance the outcome may be futile if the principles are not understood and applied correctly.[9] Explanations of how the periorbital region changes with age, the principles underlying various rejuvenation techniques, and their limitations will help investigators avoid numerous pitfalls and refine the techniques to improve patient care.[10] Furthermore, the outcome of any advance in rejuvenation techniques should be subjected to rigorous scrutiny based on a scientifically valid assessment of the anatomical and functional aspects of the periorbital region.[11] Finally, a critical evaluation of the advancement in rejuvenation techniques will spur further refinements that will benefit patients.[12] This article aims to compare the conventional techniques and Laser for lower eyelid rejuvenation.

Anatomy and Ageing Process of the Lower Eyelid

The eyelids are one of the most important components of the face, providing both aesthetic harmony and functional protection for the eyes.[13] The lower eyelids, in particular, are important for the aesthetic appraisal of the face, and as a person ages, the lower eyelids often show a range of anatomical and physiologic changes that can be a source of concern.[14] The structural anatomy of the lower eyelids and the ageing process are reviewed here, laying the groundwork for a comparative discussion on conventional and laser techniques for lower eyelid rejuvenation.[15]

The lower eyelid complex has a unique structure that plays a variety of roles in maintaining normal oculomotor physiology and the aesthetic look of the eye.[16] The exterior facial skin is continuous with the cutaneous skin of the lower eyelids.[17] The major distinguishing histologic characteristic of eyelid skin is that it has fewer sebaceous glands than facial skin.[18] Being devoid of fatty tissue, eyelid skin is the thinnest skin on the whole body.[19] The lower eyelid skin is approximately 0.3–0.6 mm thick. There are a number of furrows and rhytids in the cutaneous lower eyelid skin.[20]

Ageing causes a decrement in the density and number of collagen fibres and trabecular elastin, which causes sagging skin and the formation of rhytids.[21] Below the skin is the orbicularis oculi muscle, which is responsible for eyelid closure.[22] The orbicularis muscle is a flat and elliptical muscle that runs circumferentially and is divided into two portions: the palpebral portion and the orbital portion.[23]

The palpebral portion consists of thin fibres that form the preseptal and pretarsal parts. The tarsal plate, a fibrous connective-tissue structure that runs horizontally and is approximately 25 mm wide and 7 mm long, is attached to the medial and lateral canthal tendon, which is fixed to the anterior skull base, stabilising the eyelid.[24] A number of tarsal glands, also referred to as meibomian glands, run vertically within the tarsal plate.[25] Meibomian glands secrete an oily substance that coats the surface of the tear film and helps prevent overflow and evaporation of tears.[26] The levator palpebrae superioris muscle is attached in the upper eyelid and helps raise the upper eyelid.[27] The lower eyelid has no muscle that acts to lower it. Instead, it is held in a neutral position by the action of the upper eyelid and inferior rectus muscle, which also has a direct attachment to the globe and helps hold it in its position.[28] Under the tarsal plate is the conjunctiva, a thin mucous membrane that is transparent and vascular.[29] The conjunctiva is continuous with the bulbar conjunctiva, which coats the exposed anterior globe.[30] The eyelid is highly vascular and innervated. The major arteries supplying the eyelid are the branches of the facial and ophthalmic arteries.[31] The superior and inferior palpebral arteries are branches of the ophthalmic artery, while the inferior orbital, angular, and facial arteries arise from the facial artery.[32]

Conventional Techniques for Lower Eyelid Rejuvenation

A comprehensive overview of conventional techniques for lower eyelid rejuvenation is presented, which serves as the foundation for their evaluation against laser options[33] Recognized as the first area for aesthetic enhancement, the eyes exhibit various. signs of aging that require addressal.[34] Conventional techniques, whether surgical or non-surgical, have historically been employed for aesthetic rectification, making the discussion of their comparative analysis with laser procedures pertinent.[35] Focus is primarily given to surgical options, as they yield permanent results. Each technique, along with its indications, benefits, and limitations, is discussed, since this knowledge is crucial for patients to make informed decisions.[36] Though non-surgical techniques exist, they are generally considered inferior to surgical procedures and, therefore, not elaborated upon.[37]

All procedures are framed within the context of conventional or traditional techniques, as laser options developed later. However, it should be noted that conventional techniques were first utilized with either a dermabrader or peeler before the advent of lasers.[38] Conventional techniques, in the context of aesthetic procedures, refer to those that do not employ lasers, serums, or chemical peels.[39] For a long time, aesthetic procedures were performed using only conventional techniques, making their discussion relevant prior to modern alternatives.[40] Blepharoplasty, the most commonly performed surgical lower eyelid rejuvenation technique, is described along with two approaches,

which can be considered variations of the same technique.[41] Canthopexy, another conventional technique, is discussed as it can be performed independently or alongside blepharoplasty to enhance results.[42] In addition to effectively resolving commonly faced issues with aging, it should be noted that most conventional techniques require a longer recovery period, and the possibility of a few complications cannot be ruled out.[43]

Lower Eyelid Blepharoplasty

Lower eyelid blepharoplasty is the second most commonly performed eyelid blepharoplasty after upper eyelid blepharoplasty.[44] Age-related changes in the lower eyelids include the formation of preorbital grooves or tear troughs and the development of lower eyelid bags due to the prolapse of fat.[45] With the drooping of lower eyelid bags, the shape of the palpebral fissure also changes, resulting in an old or tired appearance.[46] Several options for lower eyelid rejuvenation are available, ranging from conventional techniques such as transcutaneous and transconjunctival lower eyelid blepharoplasty to modern laser options employing CO2 or Er:YAG lasers.[47]

Transcutaneous Lower Eyelid Blepharoplasty

A surgical procedure involving an external approach is transcutaneous lower eyelid blepharoplasty. An incision is made along the lower eyelid crease, usually 5 to 6 mm below the eyelash line, exposing the skin, orbicularis oculi muscle, and the underlying orbital septum.[48] The orbital septum is incised to expose the prolapsed fat pads of the orbit. The required fat is resected using a scissor or excised with the aid of a street knife.[49] After addressing the fat pads, the orbital septum is tightened to prevent future fat prolapse. The orbicularis oculi muscle is sutured with 6-0 vicryl, followed by a cutaneous suture to approximate skin edges, usually using 6-0 prolene in a subcuticular running fashion for cosmetic closure.[50] This technique is advantageous as it allows the simultaneous removal of skin wrinkles and redundancies along with orbital fat. However, in the past, retraction of the lower eyelid following this procedure was reported in several cases.[51]

Blepharoplasty

Blepharoplasty involves the surgical removal of the excess skin and fat from the lower eyelid. As a person ages, the periorbital region shows significant changes, which may give an impression of being tired, old or having some health problems.[52] The lower eyelids may sag and give rise to noticeable bags under the eyes. The blepharoplasty procedure is designed to revitalize this area, making the patient look younger and more alert.[53] There are basic two approaches to blepharoplasty: the transconjunctival (internal) approach, and the external incision (cut) approach.[54] The transconjunctival approach is advocated in the younger age group patients, and in patients having only fat herniation with no excess skin, while the external approach is favored in the elderly population having skin laxity along with fat herniation.[55] With the advent of modern-day lasers, diode laser assisted lower eyelid blepharoplasty was performed on a few patients.[56]

Blepharoplasty is the surgical procedure to correct abnormalities of the eyelids. The lower eyelids may develop bags due to the herniation of the fat enclosed in the orbital septum.[57] Skin laxity and wrinkles may also develop due to the change in the elastic properties of the skin.[58] The balloons under the eyes may make the patients look tired and older than their actual age. Blepharoplasty involves the removal of the excess skin and fat. To better understand the blepharoplasty surgery, it is important to understand the anatomy of the eyelids.[59] The eyelids are thin folds of skin covering the upper and lower or palpebral fissures. The chalazion involves a gland in the lid and should be treated with antibiotics and steroid injections.[60] If it doesn't resolve with treatment, then excision is done via a transconjunctival approach to prevent scarring.[61] The drop in the eyelids is known as ptosis. This may be due to the levator aponeurosis dehiscence which is seen in older patients. To treat this, a measurement of the distance from the cornea to the eyelid margin is taken. This distance is 4-5mm in normal individuals.[62] A transblepharoplasty approach corrects this distance by tightening the levator aponeurosis. A good understanding of the anatomy is important to appreciate the meaning of the various terms employed to know the eyelid abnormalities.[63]

Canthopexy

Canthopexy is a technique that directly repositions the lateral canthus. This approach is indicated for isolated lower eyelid rejuvenation when there is only subtle lateral canthal descent and no desired horizontal lid shortening.[64] A canthopexy addresses eyelid laxity, the most important change in lower eyelid aging, and stabilizes the lateral canthus to prevent further descent of the lower eyelid.[65] Properly performed canthopexy readjusts the dynamic balance of the lower eyelid and prevents the need for more invasive procedures, such as lateral canthoplasty, in the future. The lateral canthus is one of the three points that determine the contour of the eyelid.[66] Maintenance of the youthful contour of the lateral canthus is crucial in lower eyelid rejuvenation.[67] As the canthus descends with time, the lower eyelid will assume a more concave shape, giving the appearance of a less youthful and tired look.[68]

In addition, the part of the lower eyelid that borders the white of the eye (sclera) will become exposed, which can result in a condition called "scleral show" that is associated with numerous unwanted problems.[69] To avoid these situations, readjustment of the canthus is necessary when performing lower eyelid procedures.[55] The canthopexy introduced here is a modification of the conventional technique.[70] The conventional canthopexy

technique involves placing the sutures between the tarsus and the temporal dermis around the canthus.[71]

In this modification, the needle was passed through the tarsus and then exited through the incision to make a loop suture that is secured outside of the skin. This modification is straightforward, less invasive, and allows accurate placement of the canthopexy stitch.[72] The incision for the canthopexy is made only in the conjunctiva and not on the skin, thereby preventing a visible scar even in patients with tanned skin, who tend to develop hypertrophic scars when the incision is made on the skin.[73] The canthopexy is performed under a binocular microscope, thus providing an advantage in the suture technique, which can be exquisitely performed in a small and deep space compared with magnifying loupes, which do not completely overcome the difficulties encountered when performing canthal procedures.[74] The canthopexy technique described here is an effective and useful option, particularly for surgeons who are inexperienced with canthopexy or those with difficulties performing conventional canthopexy techniques.[75]

Laser Techniques for Lower Eyelid Rejuvenation

Emerging innovative alternatives for lower eyelid rejuvenation focus on integrating laser techniques and advances into conventional methods.[76] Developing as popular alternatives to traditional techniques, laser options hold great promise for the future of rejuvenation treatments. The principles behind lasers are straightforward.[77] A laser beam is generated through a medium that produces photons to excite atoms and molecules, creating excess energy. These photons are then collected and guided through a series of mirrors, generating a focused beam with similar wavelengths and phases.[78] Tightening this beam through a lens concentrates its energy. When this focused beam contacts tissue, it generates energy absorbed by the tissue, leading to thermal effects.[79]

The aesthetic application of lasers began in the 1980s when the pigment laser was introduced. Since then, various wavelengths have been developed and applied to aesthetic procedures, expanding treatment options.[80] Lasers' versatility offers a range of wavelengths for specific chromophores, precise energy delivery confined to targeted areas, and minimally invasive methods. Laser techniques can be broadly classified into two categories: ablative and non-ablative.[81] Ablative lasers remove tissue, targeting water as the main chromophore, including CO_2 and Erbium:YAG lasers. In contrast, non-ablative lasers, such as certain Nd:YAG and diode lasers, do not remove tissue but deliver energy to deeper tissue layers, primarily targeting hemoglobin, oxyhemoglobin, or water, producing thermal effects without exuding tissue.[82]

Non-ablative lasers have minimally invasive effects, leading to tighter and smoother skin through collagen contraction and fibrotic change induction, while ablative lasers are considered more aggressive methods that remove the entire epidermis and portions of the dermis.[83] Each is best suited for specific treatment goals. With the increasing demand for less invasive options, laser procedures have become more popular recently.[84] Patients seek many innovations in aesthetic medicine, preferring less invasive options with minimal recovery downtime. Additionally, the demand for more aggressive procedures has risen, making laser options appealing.[85] The potential benefits of these procedures are compelling.

Compared to traditional techniques, laser procedures offer less discomfort, faster recovery, and are highly versatile.[86] The skin is easily repaired after resurfacing procedures through tissue vaporization, minimizing recovery time. Furthermore, the versatility of laser techniques is well matched to using lasers in aesthetic applications, capable of operating at various wavelengths tailored for specific conditions.[87] Some methodologies are explored in detail in the following subsections. Specific procedures are analyzed to highlight the strengths of laser options. While enjoying the advantages of procedures reminiscing the past, possible limitations are also addressed.[88] A balanced view of laser techniques for lower eyelid rejuvenation compared to conventional methods is provided.[89]

Laser Skin Resurfacing

As laser technology advances, laser skin resurfacing has emerged as one of the well-known laser techniques for lower eyelid rejuvenation.[90] It is a laser method that removes the damaged outer layers of the skin, as a result, stimulating new collagen production and tightening the underlying skin tissue, which improves the texture of the skin.[91] By resurfacing the skin, facial rejuvenation can be achieved. Lasers used for skin resurfacing usually come in two types: ablative and non-ablative.[92] Ablative lasers remove the outer layer of the skin, while non-ablative lasers penetrate below the skin surface without disrupting the epidermis. Commonly used ablative lasers include Carbon Dioxide lasers and Erbium lasers.[93] The CO2 lasers can be used in many ways, such as fully ablative, partially ablative, and continuous wave.[94] The fully ablative CO2 lasers remove the whole epidermis and papillary dermis with little thermal damage to the surrounding skin tissues. Hence, patients experience considerable downtime, even though new collagen development occurs radically.[95]

Partially ablative CO2 lasers, on the other hand, can treat combined and resurfacing skin by removing the epidermis while maintaining the papillary dermis and treating the deeper layer. In comparison to the fully ablative lasers, the partially ablative CO2 lasers produce a less dramatic result but have less downtime.[96] The continuous wave CO2 laser is a traditional laser that has been used widely, particularly for skin resurfacing. It provides superior results in the treatment of the lower

eyelid; however, it is associated with complications like scarring and lower pigmentation of the skin.

Laser Blepharoplasty

Laser blepharoplasty is a modern adaptation of traditional blepharoplasty that utilizes laser technology to improve efficacy while reducing complications and recovery times.[97] This procedure combines standard techniques with precise laser methods, making it popular in cosmetic practices.[98] Various laser types, including erbium YAG, Q-switched, and diode lasers, are employed in the updated closed technique blepharoplasties, providing advantages over traditional surgeries.[99] Traditional blepharoplasties necessitate careful patient evaluation, while laser options appeal to those wanting minimal downtime and no visible bruising.[100] Patients on anticoagulants may find laser methods safer due to lower risks. The erbium YAG laser minimizes thermal damage to adjacent tissues and reduces side effects, while non-ablative lasers ensure minimal thermal impact, negating special pre-procedural needs. Patients are made aware of potential swelling post-surgery, especially around the lower lids, but generally experience no bruising in treated areas 86. As initial laser blepharoplasties in Asian populations were limited, comprehensive patient education on recovery expectations was provided.[101]

Comparative Analysis of Laser and Conventional Techniques

Surgical blepharoplasty has long been the standard for lower eyelid rejuvenation. Various approaches have emerged to enhance aesthetic outcomes, but traditional methods using scalpels and sutures can be invasive, with risks of hematoma, infection, necrosis, ptosis, and tissue over-resection. This highlights the need for non-invasive rejuvenation methods that reduce risks and downtime. Ablative resurfacing lasers, particularly CO2 lasers, have shown their effectiveness in reducing periorbital wrinkles, tightening skin, and treating epidermal lesions. A technique for freehand transepithelial ablation under local anesthesia can revitalize lower eyelids and address fine wrinkles.

Efficacy

Efficacy assessment reviews treatment outcomes from practitioners versus cohorts using similar techniques, particularly in comparing laser and conventional methods.[102] Rejuvenation techniques target signs of aging, as seen with transcutaneous CO_2. laser resurfacing or transconjunctival blepharoplasty for skin laxity.[103] These methods can complement each other, as lasers not only tighten but also improve texture issues like deep wrinkles and pigmentation. The distinct effects of each method influence practitioner choices and patient results.[104] Previous research has compared efficacy in rejuvenation methods, including patient satisfaction. Long-term results significantly impact patient satisfaction, underlining the need for sustained outcomes.[105] Evaluating efficacy enables practitioners to align techniques with patient needs, enhancing the comprehension of rejuvenation performance metrics.[106] Typically, these techniques focus on aging signs, especially in the upper face's periorbital area. Midface volume loss and lower eyelid laxity create a crescent shape, while fat accumulation results in a haggard look.[107]

Safety

The second key question addressed is the relative safety of each approach. As with any surgical technique, both laser and conventional techniques for lower eyelid rejuvenation have associated risks.[108] Understanding these risks is important for obtaining informed consent from patients and planning appropriate pre-operative discussions.[109] Common complications to be aware of after lower eyelid rejuvenation include infection, scarring (both hypertrophic scarring and the absence of scarring), dry eye syndrome, ectropion, and various other complications.[110] By comparing complication rates between studies for each technique, the aim is to determine which technique presents a lower risk to patients.[111] It is recognized that some of these complications would be relatively easy to overlook based on the article structures used for this analysis.[112]

To some degree, the complication rates presented are at the minds of clinicians discussing these issues with their patients rather than within the text itself.[113] Where relevant, attention is drawn to complications that would not be apparent from solely examining the data. In medical literature, laser techniques may be reported to present lower risks for certain complications. However, new laser technologies may reduce the risk of complications, as modern lasers may be less likely to damage surrounding tissues compared with older models.[114] The focus here is solely on surgical safety rather than broader safety considerations. For example, patient selection is crucial, as the same surgical approach may be safer for some patients than others owing to how individual characteristics affect safety.[115]

Recovery Time

Recovery time is another important factor from the patient's point of view. Puffy eyes are frequently present in the laser-treated group for a longer time, revealing subtissular and stromal edema, which later regresses spontaneously or upon instillation of corticoids in an ointment or cream vehicle.[116] Treatment with compressed cold-water pouches improves symptoms, with application lasting longer in the laser-treated group, in contrast to traditional surgery when benefits occur after a shorter time. Antiedema drugs and vasoconstrictors in eye drop vehicles are frequently instilled over the first few days, but the length of this therapy is variable.[117]

Decongestant ointments applied 2–3 times a week should be used during the first two months. Although the patients were allowed to socialize 24–48 hours after

traditional procedures, being given eye protectors, they were treated as ocular surgery patients.[118] In addition, frequent headache complaints were registered, possibly as a result of the elongated position, with no real social involvement.[119] Users of aesthetic medicine use makeup nearly every day; it is therefore important to clarify that traditional surgery users should wait at least three weeks, while laser treatment users cannot use it even after 1 month, due to the prolonged puffy-eye symptom.

Cost Comparison

When pursuing aesthetic enhancement, a thorough understanding of various financial implications is vital for both the patient and provider alike.[120] With the expanding arena of aesthetic procedures, providers across different disciplines will approach financial consideration from differing standpoints and experiences.[121] Generally, a cost comparison will consider direct costs associated with a particular type of procedure, with attention typically afforded to surgical fees and facility charges.[122] For lower eyelid rejuvenation, this would include an examination of relevant lasers, instruments, and supplies as well as associated surgical and facility fees.[123] Beyond these principal, most obvious expenses, attention should also be paid to other possible outlays, as well as how such expenses affect overall value. For example, if one procedure necessitates more extensive follow-up care, the related costs may nullify savings realized through lower initial costs in another approach.

Future Directions and Emerging Technologies

In lower eyelid rejuvenation, practitioners choose methodologies that reflect their philosophies and industry standards.[124] This comparative study aims to encourage others to adapt the discussed techniques or develop their own. Key trends indicate a shift towards advanced technologies, minimalist techniques, and increased patient education.[125] Advanced laser technologies are becoming prominent, achieving aesthetic results with minimal trauma and allowing for additional treatments in a single session.[126] Practitioners must keep up with these technologies while prioritizing the approaches that achieve core treatments.

Post-treatment care innovations are critical; some practices now offer new lotions or ointments post-ablative treatments, which may enhance recovery and reduce complications. The field should focus on educating patients about current options and the evolving technologies.[127] It's essential to communicate new techniques and their risks effectively, fostering patient confidence in the safety and efficacy of treatments. Ultimately, these innovations provide opportunities for growth in aesthetic practices and specifically in lower eyelid rejuvenation.[128] Aesthetic practitioners' responsibility is to keep pace with these advancements while ensuring that techniques and protocols are well-understood and optimized for patient care.

Conclusion and Recommendations

This paper compares laser and conventional techniques for lower eyelid rejuvenation through a qualitative analysis of peer-reviewed articles and case studies. It highlights the subjectivity in aesthetic assessments and the complexities surgeons face in sensitive areas like lower eyelids. A consensus emerges on best practices that minimize subjectivity, with techniques utilizing only evidence and case studies found to be superior. Combined approaches are also effective but require attention to individual patient differences. Recommendations focus on clinical outcomes while respecting patients' unique anatomies and expectations, suggesting these techniques could enhance practice but are starting points for further advances. The research suggests careful consideration of individual differences in planning rejuvenation strategies. Comparisons of techniques emphasize using documented pre- and post-operative images or standardized machine capture to reduce practitioner bias.

ACKNOWLEDGEMENTS: No one to acknowledge.

CONFLICT OF INTEREST: Authors has no conflict of interest.

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